

FORM PTO-1390 (REV 10-94)	U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE			DOCKET #: 5067-22PUS
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				
				U.S. APPLICATION NO. <small>If known, see 37 CFR 1.5</small> 107089945
INTERNATIONAL APPLICATION NO PCT/DE00/02990		INTERNATIONAL FILING DATE 28 August 2000		PRIORITY DATE CLAIMED 23 November 1999
TITLE OF INVENTION Injection Moulding Machine Comprising a Linear Motor				
APPLICANT(S) FOR DO/EO/US Gunther FISCHBACH				
<p>Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:</p> <p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input type="checkbox"/> has been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input type="checkbox"/> have been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>				
<p>Items 11. to 16. Below concern other document(s) or information included:</p> <p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p><input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information (<i>specify</i>): Int'l Preliminary Examination Report, Int'l Search Report, PCT Request, Drawings, Notification of the Recording of a Change</p>				

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 37/239945	INTERNATIONAL APPLICATION NO PCT/DE00/02990	ATTORNEY'S DOCKET NUMBER 5067-22PUS
17. [x] The following fees are submitted:		
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO \$890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482)..... \$710.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))..... \$740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... \$1040.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		
\$ 890		
Surcharge of \$130.00 for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		
\$ -0-		
Claims	Number Filed	Number Extra
Total Claims	16 - 20 =	0
Independent Claims	1 - 3 =	0
Multiple dependent claim(s) (if applicable)		+ \$280.00
TOTAL OF ABOVE CALCULATIONS =		
\$ 890		
Reduction of $\frac{1}{2}$ for filing by small entity, if applicable.		
\$ -0-		
SUBTOTAL =		
\$ 890		
Processing fee of \$130.00 for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).		
\$ -0-		
TOTAL NATIONAL FEE =		
\$ 890		
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property		
\$ 40		
TOTAL FEES ENCLOSED		
\$ 920		
		Amount to be refunded: \$
		charged: \$

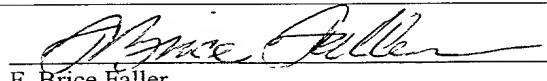
- a. [x] Two checks in the amounts of \$890.00 and \$40.00 to cover the above fees are enclosed.
- b. [] Please charge my Deposit Account No. 03-2412 in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-2412. A duplicate copy of this sheet is enclosed.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive
(37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO:

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By Express Mail # EV072606917US · April 5, 2002

Attorney Docket # 5067-22PUS**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re National Phase PCT Application of

Gunther FISCHBACH

International Appln. No.: PCT/DE00/02990

International Filing Date: August 28, 2000

For: Injection Moulding Machine Comprising a Linear
Motor**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents

Washington, D.C. 20231

BOX PCT

SIR:

Prior to examination of the above-identified application please amend the application as follows:

In the Title:

Please delete the title at page 1, line 1, and insert the following new title:

--INJECTION MOLDING MACHINE WITH A LINEAR MOTOR--

In the Specification:

Please insert at page 1, line 2, the following headings:

--BACKGROUND OF THE INVENTION

1. Field of the Invention--

Please insert at page 1, after line 5, the following heading:

--2. Description of the Related Art--

Please replace the paragraph beginning at page 2, line 4, with the following rewritten paragraph:

--An injection-molding machine is known from EP 0 280 743 B1, to which U.S. Patent No. 4,895,505 corresponds, in which a linear motion element, here a metering/injection screw, is designed as a linear motor. The linear motor has a cylindrical form, which corresponds to a movable element with a circular cross section.--

Please insert at page 3, after line 1, the following heading:

--SUMMARY OF THE INVENTION--

Please delete page 3, line 5 in entirety.

Please insert at page 4, after line 12, the following heading:

--BRIEF DESCRIPTION OF THE DRAWINGS--

Please delete at page 4, line 13 in entirety.

Please replace the paragraph beginning at page 4, line 16, with the following rewritten paragraph:

--Figure 3 shows an arresting device designed as a pair of pliers;

Please insert at page 4, line 17, the following paragraph:

--Figure 3A shows an arresting device designed as a disk brake caliper;

Please insert at page 4, after line 18, the following heading:

--DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS--

Please replace the paragraph beginning at page 5, line 11, with the following rewritten paragraph:

--An inductor comb 41 is provided in the actuating frame 21. This comb surrounds a tie bar 14, designed as a reaction rail 42, which connects the end plate 13 to the stationary mold clamping plate 11.--

Please replace the paragraph beginning at page 5, line 16, with the following rewritten paragraph:

--In the upper part of the figure, the movable mold clamping plate 12 is in the closed position. Under the end plate 13 is a four-point toggle lever 31-33. The levers 31 and 32 have passed the dead center point and can be kept in the closed position without the consumption of energy. The toggle levers 31, 32 are connected to the crosshead by the lever 33. A reaction rail 42 is attached to the crosshead; this rail is in working connection with an inductor comb 41. The inductor comb 41 is arranged parallel to another inductor comb 43, which is connected via a reaction rail 44 to the crosshead 22.--

Please replace the paragraph beginning at page 5, line 23, with the following rewritten paragraph:

--In the lower part, the movable mold clamping plate 12, which is in the open position, is connected to the crosshead 22 with a five point toggle lever.--

Please replace the paragraph beginning at page 5, line 25, with the following rewritten paragraph:

--Figure 3 is a sectional view of a lever 33, which can be held by a friction-locking component 51. In the upper part of Figure 3, the component 51 is designed as a pair of pliers, which can be held in the closed position by a spring 54. To open the pliers, a linear motor 53 is provided on the end of the handle opposite the lever 33.--

Please replace the paragraph beginning at page 6, line 4, with the following rewritten paragraph:

--In Figure 3A, the friction-locking component is designed as a disk brake caliper 52, which holds the lever 33 via compression springs 54 and which can be opened by a linear drive 53.--

Please replace the paragraph beginning at page 6, line 8, with the following rewritten paragraph:

--Figure 5 shows a free-space machine with the stationary mold clamping plate 11, which is connected via lever 33 and lever 31, connected in articulated fashion to each other, to the movable mold clamping plate 12. The toggle lever, consisting of the levers 31 and 33, is connected to a linear motor 53 consisting of the reaction rail 42 and the inductor comb 41.--

Please delete page 7, in entirety.

In the Claims:

Please cancel claims 1-16, and enter new claims 17-32, as follows:

--17. (New) A closing device for a plastics injection molding machine of the type having a stationary mold clamping plate and a movable mold clamping plate, said closing device comprising

a lever mechanism for moving the movable mold clamping plate,

a force transmission element attached to the lever mechanism, and

at least one linear motor for pivoting said lever mechanism in order to move said movable mold clamping plate relative to said stationary mold clamping plate.--

--18. (New) A closing device as in claim 17 wherein said at least one linear motor is a double comb motor.--

--19. (New) A closing device as in claim 17 wherein said at least one linear motor comprises two motors arranged pairwise one above the other.--

--20. (New) A closing device as in claim 17 wherein said force transmission element is an actuating frame, said lever mechanism comprising an outward acting toggle lever mechanism connected to said actuating frame.--

--21. (New) A closing device as in claim 17 wherein said force transmission element is a crosshead, said lever mechanism comprising an inward acting toggle lever mechanism connected to said crosshead.--

--22. (New) A closing device as in claim 17 wherein said lever mechanism is a toggle lever mechanism comprising two toggle levers.--

--23. (New) A closing device as in claim 22 wherein said toggle lever mechanism is a five point toggle lever mechanism further comprising a connecting lever connecting said force transmission element to one of said toggle levers.--

--24. (New) A closing device as in claim 17 further comprising a stationary end plate, each said linear motor comprising a reaction rail and an inductor comb, said reaction rail being fixed in said force transmission element, said comb being fixed in said end plate.--

--25. (New) A closing device as in claim 17 further comprising a stationary end plate, each said linear motor comprising a reaction rail and an inductor comb, said reaction rail being fixed to said stationary end plate, said inductor combs being fixed in at least one of said force transmission element and said movable mold clamping plate.--

--26. (New) A closing device as in claim 25 further comprising a drag line for supplying energy and coolant to said combs.--

--27. (New) A closing device as in claim 17 wherein said lever mechanism is a toggle lever mechanism which can lock the movable mold clamping plate in a closed position without being driven in the closed position.--

--28. (New) A closing device as in claim 17 further comprising an arresting device which prevents the movable mold plate from opening without being driven when said movable mold plate is in a closed position, said lever mechanism comprising at least one lever which is acted on by said arresting device...

--29. (New) A closing device as in claim 28 wherein said arresting device is in spring loaded frictional engagement with said lever when said arresting device is not driven.--

--30. (New) A closing device as in claim 28 wherein said arresting device comprises a wedge-shaped stop block which acts on said lever in a form-locking manner when said movable mold plate is in said closed position.--

--31. (New) A closing device as in claim 28 wherein said arresting device comprises a linear motor which drives said arresting device.--

--32. (New) A closing device as in claim 25 wherein at least one of said reaction rails is a tie bar fixed to said stationary end plate and to said stationary mold clamping plate, said tie bar having a hollow rectangular cross section.--

REMARKS

The specification has been amended to add headings and improve grammar to place the application in better form for examination. Other changes are for consistency with other parts of the specification and do not represent new matter. Newly submitted claims are believed to comply with 35 U.S.C. §112.

Early consideration and action on the merits are solicited.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN, PONTANI, LIEBERMAN & PAVANE

By:


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5 April 2002

By Express Mail # EV072606917US · April 5, 2002

AMENDMENTS TO THE SPECIFICATION SHOWING CHANGES

In the Specification:

Please replace the paragraph beginning at page 2, line 4, with the following rewritten paragraph:

--An injection-molding machine is known from EP 0 280 743 B1, to which U.S. Patent No. 4,895,505 corresponds, in which a linear motion element, here a metering/injection screw, is designed as a linear motor. The linear motor has a cylindrical form, which corresponds to a movable element with a circular cross section.--

Please replace the paragraph beginning at page 4, line 16, with the following rewritten paragraph:

--Figure 3 shows an arresting device designed as a [brake] pair of pliers;

Please replace the paragraph beginning at page 5, line 11, with the following rewritten paragraph:

--An inductor comb 41 is provided in the actuating frame 21. This comb surrounds a tie bar 14, designed as a reaction rail 42, which connects the end plate 13 to the stationary mold clamping plate 11--

Please replace the paragraph beginning at page 5, line 16, with the following rewritten paragraph:

--In the upper part of the figure, [we see the movable mold clamping plate between] the movable mold clamping plate 12 is in the closed position. Under the end plate 13 is a four-point toggle lever 31-33. The levers 31 and 32 have passed the dead center point and can be kept in the closed position without the consumption of energy. The toggle levers 31, 32 are connected to the crosshead by the lever 33. A reaction rail 42 is attached to the crosshead; this rail is in working connection with an inductor comb 41. The inductor comb 41 is arranged

parallel to another inductor comb [42] 43, which is connected via a reaction rail 44 to the crosshead 22.--

Please replace the paragraph beginning at page 5, line 23, with the following rewritten paragraph:

--In the lower part, [between] the movable mold clamping plate 12, which is in the open position, [with a five-point toggle lever,] is connected to the crosshead 22 with a five point toggle lever--

Please replace the paragraph beginning at page 5, line 25, with the following rewritten paragraph:

--Figure 3 is a sectional view of a lever 33, which can be held by a friction-locking component 51. In the upper part of Figure 3, the component 51 is designed as a [set of grippers] pair of pliers, which can be held in the closed position by a spring 54. To open [these grippers] the pliers, a linear motor 53 is provided on the end of the [grippers] handle opposite the lever 33.--

Please replace the paragraph beginning at page 6, line 4, with the following rewritten paragraph:

--In [the lower part of the figure] Figure 3A, the friction-locking component is designed as a disk brake caliper 52, which holds the lever 33 via compression springs 54 and which can be opened by a linear drive 53.--

Please replace the paragraph beginning at page 6, line 8, with the following rewritten paragraph:

--Figure 5 shows a free-space machine with the stationary mold clamping plate 11, which is connected via lever 33 and lever 31, connected in articulated fashion to each other, to the movable mold clamping plate 12. The toggle lever, consisting of the levers 31 and [32]

33, is connected to a linear motor 53 consisting of the reaction rail 42 and the inductor comb 41.--

INJECTION MOULDING MACHINE COMPRISING A LINEAR MOTOR

S P E C I F I C A T I O N

The invention pertains to a closing device in the form of an injection molding machine for plastics with a stationary mold clamping plate and with a movable mold clamping plate, which can be operated by a linear motor.

A closing unit in which the end plate cooperates with the plunger to form a linear motor is known from DE 37 15 161 A1. The 3-phase windings are provided in the end plate and the plunger is designed as a "rotor" rail.

The disadvantage of this design is the relatively weak closing force which can be exerted by the linear motor. In another embodiment, therefore, an electromagnet is provided to produce the required closing pressure; when current is flowing through this electromagnet, it induces a force on the plunger directed toward the mold.

The efficiency of linear motors is especially poor at low speeds and when no motion at all is occurring. In the design described in the previously cited document, however, the maximum demand for force occurs as the closing force is being built up. The only movement which occurs in this phase is that which results from the expansion of the tie bars. This leads to an uneconomically large installation cost for the linear motor and for the converter required to operate the drive.

It must also be expected that the amount of energy consumed will be uneconomical in comparison with rotating motors. This disadvantage cannot be avoided by the use of a divided end plate provided with electromagnets to build up the closing force. The expansion of the tie bars leads in this solution to a considerable widening of the air gap and thus to a drastic drop in the amount of force which can be transmitted. The only way to compensate for this is to increase the size of the magnets of the tie bar to an uneconomical extent.

In the proposed solution, furthermore, the closing force must continue to be actively applied during the injection, holding pressure, and cooling phases, which means that large amounts of energy must be consumed continuously.

An injection-molding machine is known from EP 0 280 743 B1, in which a linear motion element, here a metering/injection screw, is designed as a linear motor. The linear motor has a cylindrical form, which corresponds to a movable element with a circular cross section.

This design is called a solenoid motor and is used for applications with low force requirements. Solenoid motors achieve only a fraction of the force which can be generated by linear motors of the single-comb or multi-comb type.

The forces required to move the screw of an injection molding machine in a linear manner cannot be compared with the closing forces required to close the mold of an injection-molding machine; that is, they are typically are 5-10 times smaller. Because no additional rotational movements of the axle, which is moved in a linear fashion, are required to close the mold, a solenoid motor offers only disadvantages for this application.

A plastic injection-molding machine is known from DE 38 18 599 A1, in which at least some of the working elements are driven by arrangements of electrically superconducting magnets, the conductors of which are cooled by a coolant to a temperature below the transition point. One of these working elements is a toggle lever for closing the mold, for which electrically superconducting linear electromotors are provided for the linear motion.

This device suffers from the disadvantage that, to achieve the transition temperature required for the superconducting state, a conductor winding is required which consists of a special alloy, which must also be cooled. An alloy of this type consists in particular of the expensive metal lanthanum or yttrium, plus barium, copper, and oxygen. The transition temperature is reached in particular by the use of liquid nitrogen and is thus associated with

significant technical effort.

The invention has the goal of creating a closing device of the general type in question which makes it possible by means of a simple design to move the movable mold clamping plate and to hold it in position at low expenditure of energy and without contamination.

The invention achieves this goal by means of the features of Claim 1.

According to the invention, at least one linear motor is connected to a force transmission element, which is connected in turn to a lever mechanism. This force transmission element can be designed as a crosshead or as an actuating frame.

Double-toggle levers are used here, where four-point and five-point toggle levers are preferred.

The geometry of the individual levers and the control program are selected so that, in the closed position of the movable mold clamping plate, the plate is held without any consumption of energy during the closed phase.

To achieve an especially short design, the linear motors are installed between the force transmission element and either the end plate or the movable mold clamping plate. In an especially advantageous design, the stationary part is attached to the end plate, and the mobile part is attached to the force transmission element. As a result, there is no need for a drag line.

In another advantageous design, a tie bar of the closing unit is used as the reaction rail of the linear motor.

During the closed phase of the movable mold clamping plate, the linear motors are turned off. As a result of this measure, the noise level is reduced and energy is also saved.

This is achieved by the use of toggle levers, which have such dimensions and are actuated in such a way via a control program that the dead center point is passed.

In another design, an arresting element is provided, which, during the closed phase, holds or grips at least one lever in a form-locking or friction-locking manner. The arresting

elements are designed so that drive energy is required only for the locking and unlocking processes.

According to the invention, linear motors are used in a pairwise arrangement. As a result of this design, the gap forces are essentially compensated.

An essential advantage of the invention is that the linear motion is produced directly, without the need to convert a rotation into a translation by the use in particular of a gear transmission. The elimination of a transmission minimizes the maintenance work required and increases the reliability of the machine. Without a transmission, the drive operates without any hysteresis or clearance at all, which increases the precision and the controllability of the motion.

The principle of the linear drive imposes no limit of any kind on the speed or on the force of the motion, as is associated with a solution in the form of a transmission or a worm.

An example of the invention is shown in the attached drawing:

Figure 1 shows a closing device with an actuating frame;

Figure 2 shows a closing device with a crosshead;

Figure 3 shows an arresting device designed as a brake;

Figure 4 shows an arresting device designed as a stop block; and

Figure 5 shows a free-space machine.

Figures 1 and 2 show an injection molding machine with a stationary mold clamping plate 11, a movable mold clamping plate 12, and an end plate 13. An injection cylinder 15 is mounted on the stationary mold clamping plate. The mold 16 is attached to the mold clamping plates 11, 12.

Figure 1 shows an injection-molding machine with a force transmission element, which is designed as an actuating frame 21.

The movable mold plate 12 can be seen in the open position in the upper part of the

figure. Between the movable mold clamping plate 12 and the actuating frame 21 is a five-point toggle lever 31-33.

The inductor combs 41, 43 of two linear motors are arranged in a pairwise manner as double-comb motors in the actuating frame. The reaction rails 42, 44 are connected to the end plate 13.

To supply energy and cooling water, the actuating frame 21 is connected by way of a drag line 45 to the end plate.

The movable mold clamping plate can be seen in the closed position in the lower part of the figure. Between the mold clamping plate 12 and the end plate 13 there is a four-point toggle lever 31-33.

An inductor comb 41 is provided in the actuating frame 21. This comb surrounds a tie bar 14, designed as a reaction rail 42.

Also in the lower part of the figure, we see that the tie bar 14 is guided by a second inductor comb 43, which is mounted in the movable mold clamping plate 12.

In Figure 2, the force transmission element is designed as a crosshead 22.

In the upper part of the figure, we see the movable mold clamping plate between the movable mold clamping plate 12. Under the end plate 13 is a four-point toggle lever 31-33. The levers 31 and 32 have passed the dead center point and can be kept in the closed position without the consumption of energy. The toggle levers 31, 32 are connected to the crosshead by the lever 33. A reaction rail 42 is attached to the crosshead; this rail is in working connection with an inductor comb 41. The inductor comb 41 is arranged parallel to another inductor comb 42, which is connected via a reaction rail 44 to the crosshead 22.

In the lower part, between the movable mold clamping plate 12, which is in the open position, with a five-point toggle lever, is connected to the crosshead 22.

Figure 3 is a sectional view of a lever 33, which can be held by a friction-locking

component 51. In the upper part of Figure 3, the component 51 is designed as a set of grippers, which can be held in the closed position by a spring 54. To open these grippers, a linear motor 53 is provided on the end of the grippers opposite the lever 33.

In the lower part of the figure, the friction-locking component is designed as a disk brake, which holds the lever 33 via springs 54 and which can be opened by a linear drive 53.

Figure 4 shows a form-locking component, here in the form of a wedge 55, which can be moved against the lever 33 by a linear motor 53.

Figure 5 shows a free-space machine with the stationary mold clamping plate 11, which is connected via lever 33 and lever 31, connected in articulated fashion to each other, to the movable mold clamping plate 12. The toggle lever, consisting of the levers 31 and 32, is connected to a linear motor consisting of the reaction rail 42 and the inductor comb 41.

Parts List

Injection-Molding Machine

- 11 stationary mold clamping plate
- 12 movable mold clamping plate
- 13 end plate
- 14 rollers
- 15 injection cylinder

Force Transmission

- 21 actuating frame
- 22 crosshead (force transmission element)

Levers

- 31 lever connected to 11
- 32 lever connected to 13
- 33 lever connected to 21, 22
- 31, 32 (toggle levers)

Drive

- 41 first inductor comb
- 42 first reaction rail (linear motor)
- 43 second inductor comb
- 44 second reaction rail
- 45 drag line

Arresting

- 51 friction-locking component (brake)
- 52 form-locking component (stop block)
- 51, 52 arresting device
- 53 drive for 51, 52

CLAIM(S)

1. Closing device in the form of an injection molding machine for plastics with a stationary mold clamping plate and a movable mold clamping plate, which can be operated by a linear motor, characterized in that at least one linear motor (41, 42) is connected to a force transmission element (21, 22), which is connected to a lever mechanism (31-33).
2. Closing device according to Claim 1, characterized in that the force transmission element (21, 22) is an actuating frame (21), to which an outward-acting toggle lever mechanism (31-33) is connected.
3. Closing device according to Claim 1, characterized in that the force transmission element (21, 22) is a crosshead (22), to which an inward-acting toggle lever mechanism (31-33) is connected.
4. Closing device according to Claim 2 or Claim 3, characterized in that the toggle lever mechanism (31-33) has a double-toggle lever.
5. Closing device according to Claim 4, characterized in that the toggle lever mechanism (31-33) is a five-point toggle lever, in which the lever (33) connected to the force transmission element (21, 22) is connected directly to one of the levers (31 or 32).
6. Closing device according to one of the preceding claims, characterized in that at least two linear motors (41, 42 and 43, 44) are provided, which are designed in pairwise fashion as double-comb motors.
7. Closing device according to at least one of the preceding claims, characterized in that the reaction rail (42) of the linear motor (41, 42) is connected to the force transmission element (21, 22), and in that the inductor comb (41) of the linear motor (41, 42) is connected to the end plate (13) or to the movable mold clamping plate (12).
8. Closing device according to at least one of the preceding claims, characterized in

that the inductor comb (41) of the linear motor (41, 42) is moved, and in that a drag line (45) for supplying energy and coolant is provided.

9. Closing device according to Claim 5, characterized in that the toggle levers (31, 32) have dimensions such that, when the movable mold clamping plate (12) is in the closed position, it is locked in place without drive.

10. Closing device according to at least one of the preceding claims, characterized in that at least one lever (31-33) is connected to an arresting device (51, 52), which, when the movable mold clamping plate (12) is in the closed position, prevents the plate from opening without drive.

11. Closing device according to Claim 10, characterized in that the arresting device (51, 52) is a component (51) which closes in a friction-locking manner, especially a component in the form of a spring-actuated brake.

12. Closing device according to Claim 10, characterized in that the arresting device (51, 52) is a component (52) which arrests in a form-locking manner, especially a component in the form of a wedge-shaped stop block.

13. Closing device according to Claim 11 or Claim 12, characterized in that the drive (53) of the arresting device (51, 52) is a linear motor.

14. Closing device according to Claim 2 or Claim 3, characterized in that, in an injection-molding machine which has tie bars (14), at least one of these tie bars (14) is designed as a reaction rail (42).

15. Closing device according to Claim 14, characterized in that the tie bar (14) has a rectangular cross section, especially a tie bar in the form of a hollow section.

16. Closing device according to Claim 2 or Claim 3, characterized in that, in the case of an injection-molding machine designed as a clearance machine, a toe member is designed as a reaction rail (42).

ABSTRACT

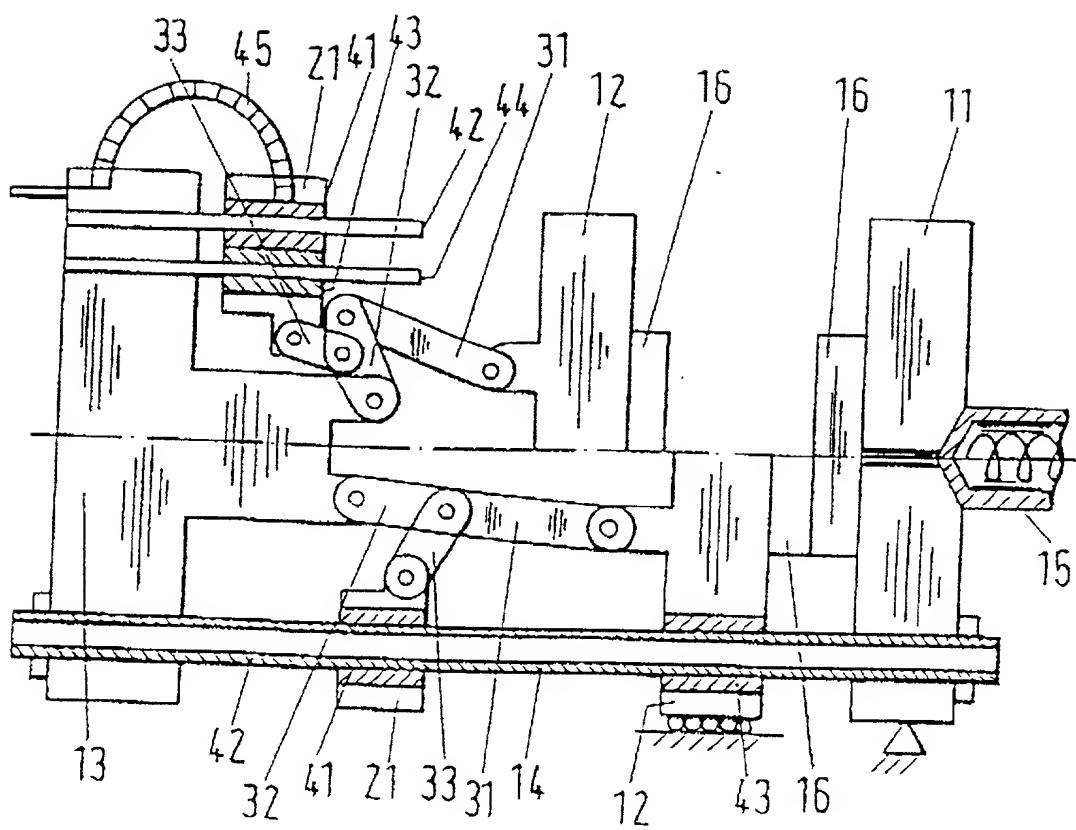
The invention pertains to a closing device in the form of an injection-molding machine for plastics with a stationary mold clamping plate and a movable mold clamping plate, which can be operated by a linear motor. At least one linear motor (41, 42) is connected to a force transmission element (21, 22), which is connected to a lever mechanism (31-33).

Figure 1.

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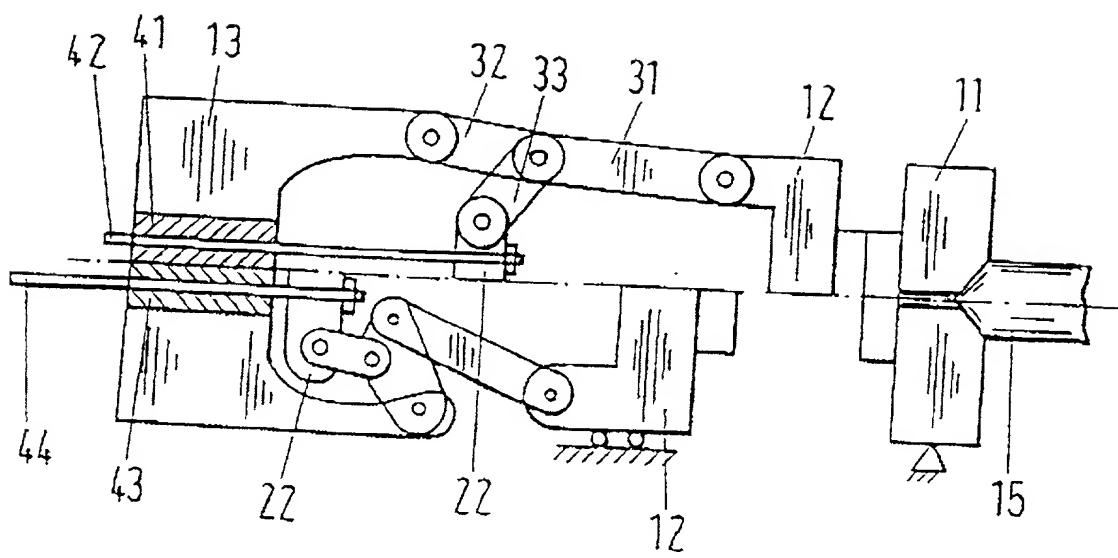
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Fig.1



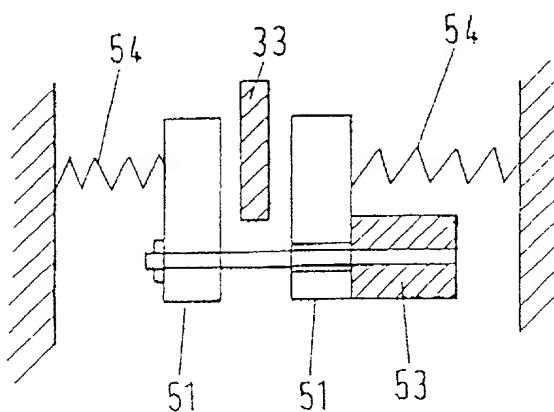
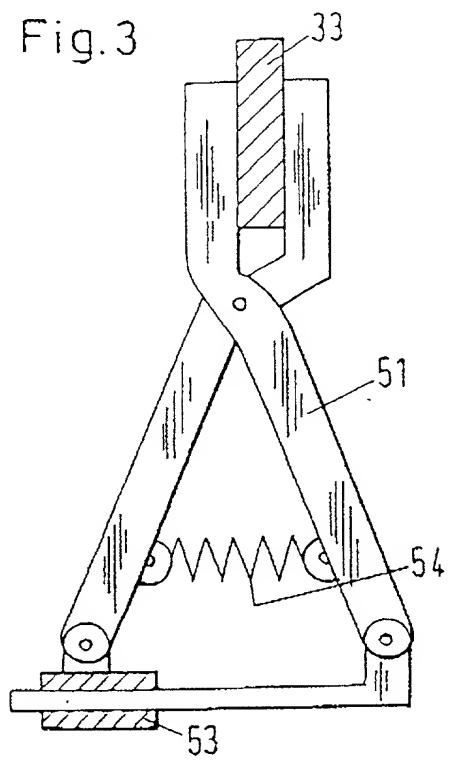
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Fig. 2



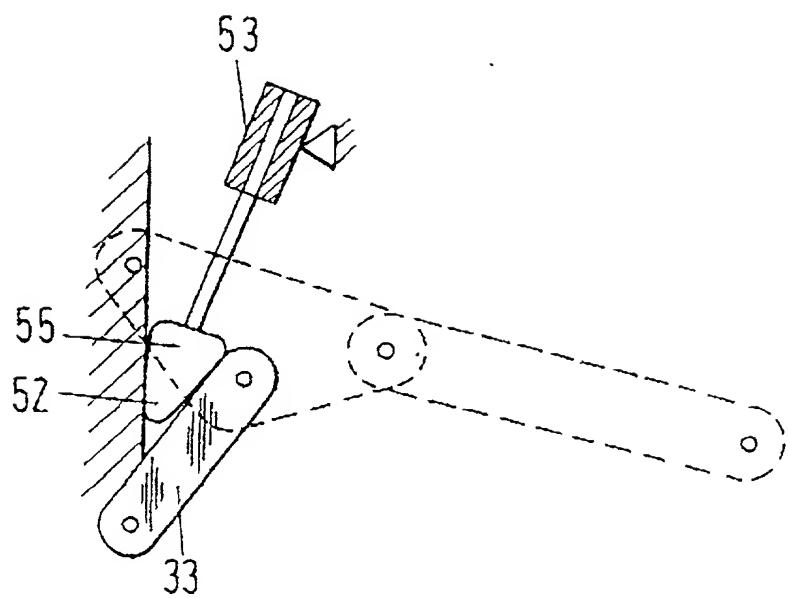
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Fig.3



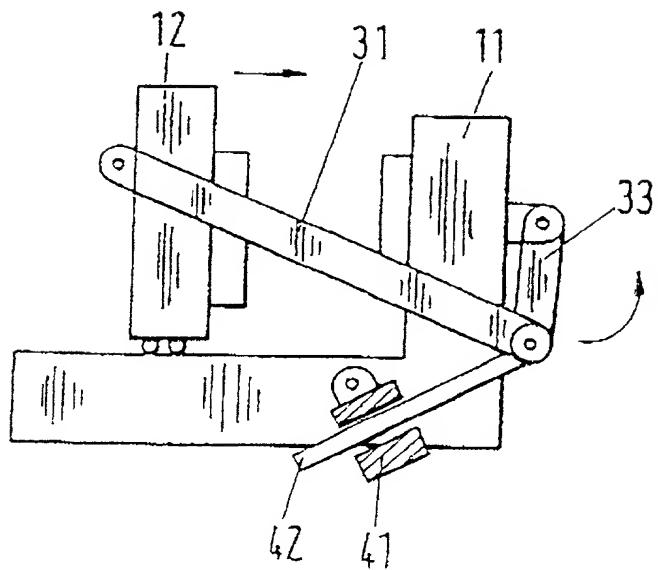
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Fig.4



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Fig.5



COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY Includes Reference to PCT International Applications		Attorney's Docket No.5067-22PUS
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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

INJECTION MOULDING MACHINE COMPRISING A LINEAR MOTOR

the specification of which (check only one item below)

is attached hereto
 was filed as United States application

Serial No.

on

and was amended

on _____ (if applicable).

was filed as PCT international application

Number PCT/DE00/02990

on 28 August 2000

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Germany	199 57 485.5	23 November 1999	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
PCT	PCT/DE00/02990	28 August 2000	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO

Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)		Attorney's Docket 5067-22PUS
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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application.

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)		
PCT/DE00/02990	28 August 2000		X	

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (*List name and registration number*)

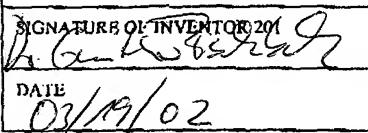
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	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

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2 0 3	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201 	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 03/19/02	DATE	DATE